X – Ray tube

Target:

The target is the area of the anode struck by the electrons from the cathode. In stationary – anode tubes the target consists of a tungsten – alloy metal embedded in the copper anode. In rotating – anode tubes the entire rotating disc is the target. Alloying the tungsten (usually with rhenium) gives it added mechanical strength to withstand the stress of the high rotation.

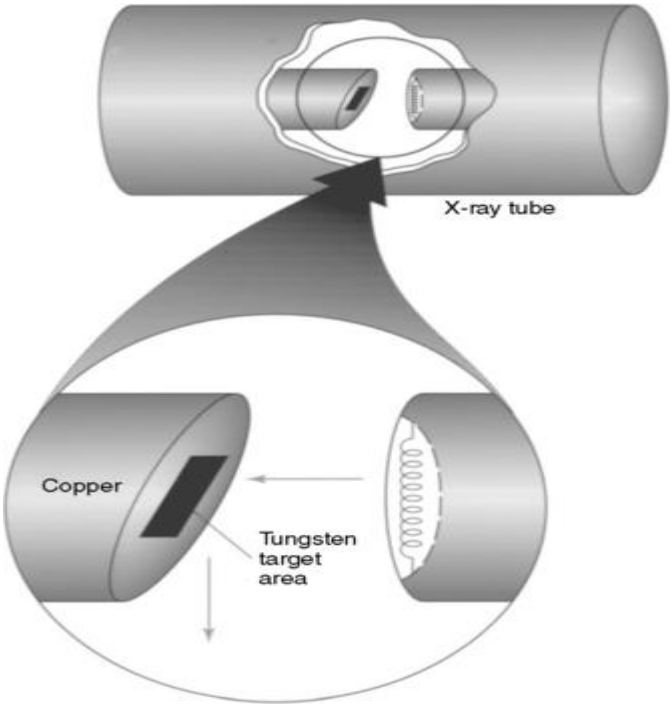

Fig (1): target of the x-ray

The Benefits of Using Tungsten as A Target Material:

- Atomic number: Tungsten's high atomic number ,74, results in higher – efficiency x – ray production and in higher – energy x – rays.
- Thermal conductivity: Tungsten has a thermal conductivity nearly equal to that of copper. it is therefore an efficient metal for dissipating the heat produced.

- High melting point: Any material, if heated sufficiently, will melt and become liquid . tungsten has a high melting point (3410 C°) and therefore can stand up under high tube current without pitting or bubbling.

- The anode target must be a good thermal conductor, when the electrons comprising the tube current slam into the anode, more than 99% of their kinetic energy is converted into heat. This heat must be conducted away quickly before it can melt the anode. copper is the most common anode material.

- Resists vaporization at high temperatures.

- Its availability makes it cost-effective.

Fig(2): Tungsten Filament

The distance between the cathode and the rotating anode disc is very close. This is designed this way to ensure that the projectile electron stream has a reasonably good chance of arriving at the anode in a relatively tight pattern. If the electrons were permitted to spread out, then the x-ray production process would become very inefficient.

Another important device that limits the beam to a specific size called **collimator.** The collimator has a series of metal leaves that overlap to different sizes. The technologist can adjust the field of radiation to whatever size image receptor (film) is being used. Collimators can also function automatically in that when the film is positioned in the table film tray, the collimator can sense the dimensions of the image receptor and limit the beam to that size. This is known as PBL or positive beam limitation.

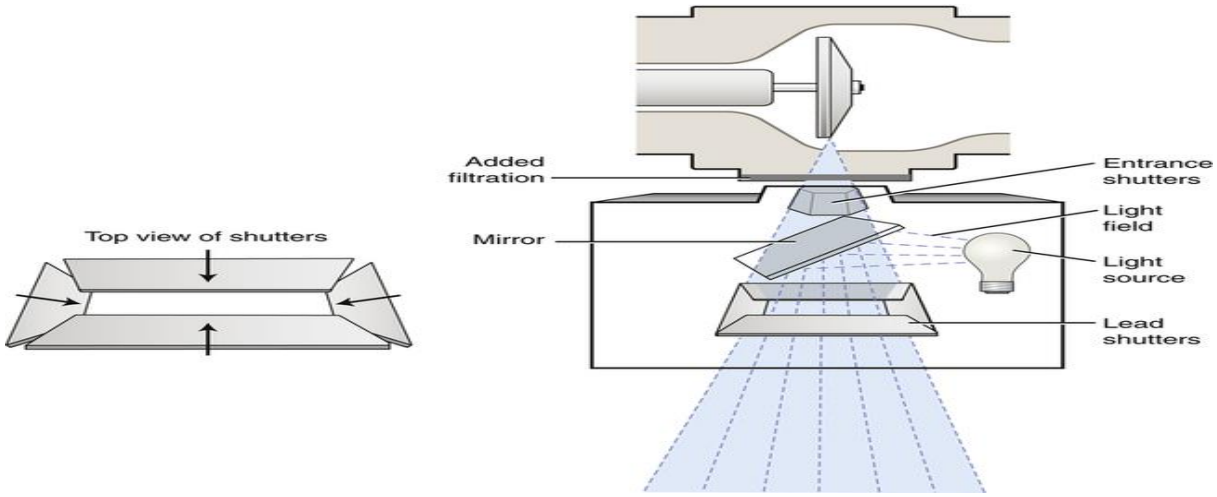

Fig **(3): The collimator**

Glass envelope:

Is the container of the x – ray tube components, which supports the anode and cathode structures. which is usually made of Pyrex glass to enable it to withstand the tremendous heat generated, maintains a vacuum inside the tube, this vacuum allows for more efficient x-ray production and longer tube life. If the tube were filled with gas, the electron flow from cathode to anode would be reduced, fewer x – rays would be produced, and more heat would be created.

A recent improvement in tube design incorporates the metal rather than glass as part or all of the envelope. As glass envelope tubes age. Some tungsten vaporizes and coats the

inside of the glass envelope. This alters the electric potential of the tube, allowing tube current to stray and interact with the glass envelope, the result is arcing and tube failure.

Metal envelope tubes maintain a constant electric potential between the electrons of the tube current and the envelope. Therefore, they have longer life and are less likely to fail. Virtually all high – output x-ray tubes now use metal envelopes.

The tube window is a segment of the glass envelope, approximately 5 cm2 , that contains a thin section of glass through which the useful beam of x-rays is emitted. The thin window serves to allow maximum emission of x-rays with minimum absorption in the glass envelope.

Fig (4): Glass envelope

Protective housing :

The x – ray tube is always mounted inside a lead – lined protective housing designed to control two serious hazards that plagued early radiology :

Excessive radiation exposure Electric shock The protective housing also provides mechanical support for the x – ray tube and protects the tube from damage caused rough handling. The protective housing around some x – rays tubes contains oil that serves as both an electrical insulator and a thermal cushion. Some protective housings have a cooling fan to air – cool the tube or the oil in which the x – ray tube is immersed**.**